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September/October Energy Figures Released

Sep 89

40100006 Beijing CEI Database in English 9 Nov 89

[Text] Beijing (CEI)—Following is a list of China's total output of primary energy production in September, 1989, released by CSICSC [China Statistics Information Consultancy Service Center]:

Item	Unit	1-9/89	9/89	Percentage over 1-9/89
Total output (10,000 tons of standard coal)		73,186.0	8,471.0	106.90
A. Raw coal	10,000t	74,862.0	8,699.0	108.70
including: Output under unified central planning	10,000t	35,239.0	4,022.0	106.00
B. Crude oil	10,000t	10,204.0	1,148.2	100.80
C. Natural gas	100 million cubic meters	112.42	12.47	105.00
D. Hydropower	100 million kWh	902.9	112.0	108.70

Oct 89

40100009 Beijing CEI Database in English 27 Nov 89

[Text] Beijing (CEI)—Following is a list of China's total output of primary energy production in October, 1989, released by CSICSC [China Statistics Information Consultancy Service Center]:

Item	Unit	1-10/89	10/89	Percentage over 1-10/89
Total output (10,000 tons of standard coal)		81,636.0	8,455.0	107.00
A. Raw coal	10,000t	83,508.0	8,645.0	108.70
of: Planned	10,000t	39,225.0	3,986.0	106.00
B. Crude oil	10,000t	11,400.6	1,196.4	100.80
C. Natural gas	100 m cm	123.95	12.22	104.50
D. Hydropower	100 m kWh	1,004.8	101.7	108.70

Guidelines Set for Development of Energy Industry

906B0013B Beijing JINGJI RIBAO in Chinese 27 Aug 89 p 2

[Text] For the purpose of national economic development, the Ministry of Energy Resources recently set forth a basic policy for the development of the energy industry in China for the rest of this century. Centered on electric power based on coal, the guidelines also call for a major effort in the development of hydroelectric power and nuclear power, active development of petroleum and natural gas, improvement of the energy structure, and serious conservation programs for electric power and oil. Experts believe that by the year 2000 China's primary energy resources should reach 1.4 billion tons of standard coal, including 1.4 billion tons of raw coal, 200 million tons of crude oil, 80 million kilowatts of installed hydroelectric power, 240 billion kilowatt-hours of power output and 30 billion kilowatt-hours of nuclear power.

In order to achieve the above goal, experts have proposed strategic development plans for coal, electric power, and petroleum. The development priority for the coal industry will be in Shanxi, Shaanxi, western Nei Mongol, northeastern China, and the eastern region. The development of electric power should be done in close coordination with coal conservation and transportation conservation. In the area of thermal electric power, the emphasis should be on the development of pit-mouth

power plants. The coal mining and electric power generation should be combined in order to transmit power rather than ship coal. The emphases on hydroelectric power development are the upper and middle reaches of the Huang He, the main stream and tributaries of the upper reaches of the Chang Jiang, the Hongshui He, and the Lancang Jiang. The development of nuclear power should stress the Qinshan and Daya Wan stations now under construction, and the rapid development and perfection of the manufacturing technology for nuclear power plants. The first priority in petroleum development is to find more oil reserves. Experts believe that the current exploration approach should be to stabilize the old oil fields in the east, and speed up the exploration of the west—especially in Qinghai and Xinjiang—in order to achieve the goal of 200 million tons of crude oil production per year by the year 2000.

Solution to Jilin's Critical Energy Shortage Analyzed

906B0013A Changchun JILIN RIBAO in Chinese 6 Sep 89 p 2

[Article by Zhang Guoshan [1728 0948 3790]]

[Excerpts] [Passage omitted]

Crisis and Difficulty

Since the Revolution, energy production in Jilin has increased considerably; growth in the primary energy production has been nearly six-fold. In the area of energy conservation there have also been achievements; energy consumption per 10,000 yuan of production dropped from 10.01 tons in 1980 to 6.6 tons in 1988. However, the rate of development and conservation efforts has not reduced the huge gap between supply and demand. What is worrisome is that in the short-run the economic development of Jilin will have difficulties.

The development of the energy industry has always been limited by the shortage of resources. Jilin is one of the provinces with a short-term shortage of energy resources. Verified oil and coal reserves in Jilin are less than 1 percent of that of the nation. Most of the coal mines in Jilin's unified distribution mines are old mines with an average life of only about 16 years. In 1988 the production of Jilin's unified distribution coal mines in fact decreased by 210,000 tons. In the area of hydroelectric power, the cascade power stations on Songhua Jiang have been completed. Other than the expansion project at the Baishan power station, there are no other possibilities for major hydroelectric power stations. Although there have been some breakthroughs in oil exploration, they cannot solve the energy shortage problem.

Difficulties in energy conservation technological improvement and shortages in capital have impeded the effort to lower energy consumption. Improvements in energy conservation techniques can not only raise the standard of the technology and facility, but also produce noticeable conservation benefits. Jilin has great potential for conservation, but the efforts are plagued by serious shortages in funds. The increasingly high costs of conservation projects have aggravated the problems. In 1980 it cost about 200 yuan to conserve a ton of standard coal; today it costs 467.7 yuan.

The conflict between energy-intensive industries and base industries must be resolved. To produce the same value of production, heavy industry consumes twice as much energy as light industry. Some badly needed industries and products with low energy costs, however, are energy-intensive but also are important financial avenues for generating profits. Examples are the Jilin Steel Alloy Plant and the Jilin Carbon Plant. Known as the "100-million-yuan plants," they consume one-fifth of Jilin's industrial electric power.

Difficulties exist in importing energy from other provinces. Jilin's energy imports increased from 6.076 million tons in 1980 to 13.583 million tons in 1988. Then came widespread energy shortages throughout China and sources became difficult to find. Limited by transportation capacity, long-distance hauling of coal is uneconomical, costing some 100 million yuan per year.

Based on the growth rate in the last 12 years, energy consumption in Jilin will reach 55 million tons by the end of this century, but there will also be a shortfall of 22 million tons. According to the national average energy consumption per 10,000 yuan of production, this shortfall will cause a loss of 14.3 billion yuan in production value and 2.1 billion yuan in tax income. This worrisome scenario teaches us that without strong conservation measures, Jilin's economy will be in greater trouble.

[Passage omitted] We should improve the exploration and development of energy resources in Jilin and increase the degree of self-reliance. We should realize that even though Jilin is a province with energy shortages, it has its own potential for development and utilization. For example, the development potential for oil shale, methane, solar energy, hydroelectric power, wind power, and geothermal energy is great. According to data, less than one-hundredth of 1 percent of the oil shale has been developed, less than 10 percent of small hydropower, capable of powering a million kilowatts of generators, is utilized, and village fuel needs will be solved if 30 percent methane gas is used.

We should adopt an investment preference policy to accelerate the development of the electric power industry. In order to restore and maintain the leading position of the electric power industry, investment preference must be first placed on electric power. Next, a liberal policy should be adopted in taxes and prices so that profits from electric power are higher than that in other industries in order to encourage investment in electric power development. In addition, we should insist on the leading role of thermal electric power while developing both thermal and hydroelectric power and developing a nuclear power policy. Based on the resources in Jilin, the development of electric power

should be done in steps and in a diversified manner. The specific steps are as follows: First, properly plan the development of large electric power plants at transportation hubs and at mine sites. The power plants at transportation hubs can make use of coal imported from other provinces and can help the development of oil shale. These new resources can then be used for the establishment of power plants at mine sites. Power plants at sites of rich mineral resources can reduce the demand and cost of transporting the coal. Next, there should be a vigorous effort to develop nuclear power. In China the technology for nuclear power has matured and there are experiences to follow. Already under construction are the Daya Wan nuclear power plant and the Qinshan nuclear power plant. The early phase engineering of the two nuclear power plants in Liaoning has been completed and the rest of the work is ready to begin. Jilin should take advantage of this opportune time, draw on the experience of other domestic and foreign nuclear power plants, make some early plans in order to begin the construction of nuclear power as soon as possible. Finally, we should develop Jilin's hydroelectric resources. Construction of the second phase engineering of the Baishan power plant should be accelerated. Efforts should be devoted to the construction of the Shuanggou and Xiaoshan cascade power stations and plans made to build pumped-storage power stations.

We must improve our management standards and work to conserve energy. Of the 17 priority enterprises targeted for energy conservation in 1988, almost half exceeded their planned energy consumption; 11 enterprises (or 64.7 percent) did better than the provincial average. In the meantime, conservation efforts were uneven; for example, of the five petroleum processing enterprises, the lowest energy consumption per 10,000 yuan of production was 2.85 tons [of standard coal equivalence], and the highest was 18.3 tons.

The industrial structure should be adjusted to reduce energy consumption. The energy-intensive industries with low degrees of processing were formed in Jilin historically; this structure permitted the outflow of a great amount of energy with intermediate products. Jilin exports 5.6 billion yuan of raw material annually; this is equivalent to 5.41 million tons—or 27.5 percent of industrial energy consumption—of energy export. We must have the determination to adjust the industrial structure and seize the opportunity to develop industries with high degrees of processing to take advantage of the raw material resources in Jilin.

We should quicken the pace for technological reform and raise the rate of energy utilization. Technological reform requires great amounts of capital, which is a problem as well as a strategic necessity. We might take an approach of collecting funding from a number of sources and gradually proceed from easier projects to more difficult ones. If the existing energy-intensive facilities and industrial technologies can be improved to the 1970's level of foreign countries and the energy utilization rate can be raised to 40 percent by the end of this century, then 6.351 million tons will be saved while achieving the same level of production.

1,000-Kilometer Power Line Goes Into Operation

40100005B Beijing XINHUA in English 1553 GMT 6 Nov 89

[Text] Xian, November 6 (XINHUA)—An ultra-high tension two-way transmission line from the Longyangxia hydroelectric power station, the largest of its kind on the Yellow River, to the Qinling power station went into operation today.

Costing 73.63 million yuan (about $19.9 million) the line is 1,000 km long and its maximum power transmission capacity will be 400,000 kW.

It will help alleviate energy shortages in northwest China's Shaanxi, Gansu, and Qinghai provinces.

International Bidding Opens on Huge Ertan Project

40100004A Beijing XINHUA in English 1552 GMT 28 Oct 89

[Text] Chengdu, October 27 (XINHUA)—International bidding opened here on Wednesday for the Ertan hydropower station project on the Yalong River in Sichuan Province, which has China's largest hydroelectric resources.

The station, to be built with World Bank loans, will have a total generating capacity of 3,300,000 kilowatts, making it the largest in China.

Six of the 14 contractors and cooperative firms, who have turned in qualifying documents, have already passed the qualification process.

Cooperative firms include Philipp Holzman-Hochtief and Bilf Incer-Bercer of the Federal Republic of Germany, Sogea and Sae of France, and Impregild S.P.A. of Italy.

The winning bids will be selected in April 1990.

The project is expected to be completed by 1999.

Wanan Station Update

40100005A Beijing XINHUA in English 1055 GMT 4 Nov 89

[Text] Nanchang, November 4 (XINHUA)—The Gan Jiang was blocked with cofferdams on Friday in preparation for the construction of the Wan'an Hydropower Station in east China's Jiangxi Province.

Designs call for the station to have a capacity of 500,000 kilowatts and to generate 1.935 billion kilowatt-hours of electricity annually. It is the first power station on the Gan Jiang and one of the key projects of the country's Seventh 5-Year Plan (1986-1990).

The power station's permanent dam will have a storage capacity of 2,100 million cubic meters, enough to irrigate about 20,000 hectares of farmland.

More than 200 kilometers of channel on the upper reaches of the Gan Jiang will also be improved.

The station will provide electricity for central and south China after completion in 1992.

Shuikou Project Gets Under Way With Blocking of Min Jiang

40130005 Shanghai JIEFANG RIBAO in Chinese 26 Sep 89 p 3

[Text] Fuzhou, 25 September—Today, the flow of the main stream of the Min Jiang was blocked [in preparation] for the construction of the Shuikou hydroelectric power station in Fujian Province, a major item on the state's Seventh 5-Year Plan construction agenda.

Originally begun in March 1987, the Shuikou hydropower project's primary purpose is that of generating electricity, with secondary roles of improving navigation, etc. Total installed capacity will be 1.4 million kilowatts. It is to be the largest hydropower station in east China. At the same time, it will improve navigation on the Min Jiang for some 100 kilometers above its dam.

The project, approved by the State Council, is using a World Bank construction loan, marking the first time that China has opened up to international bidding on civil construction jobs on the main parts of a major hydroelectric power project. It is a joint investment project involving the Maeda Construction Company, Ltd. of Japan.

Dongjiang Station Now in Operation

40130002A Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 30 Sep 89 p 3

[Summary] The completion of the four generating units of the key Dongjiang energy construction project in Hunan Province was announced on the eve of National Day. The station has a total installed capacity of 500,000 kilowatts and a yearly power output of 1.32 billion kWh. The reservoir covers 240,000 mu, and its maximum reserve capacity will be 9.1 billion cubic meters. The station has been constructed mainly for generating electric power, but will also provide such benefits as flood control, navigation and fish-breeding.

Guangzhou Pumped-Storage Station Update

40130002B Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 3 Oct 89 p 3

[Summary] The Guangzhou pumped-storage station—the nation's first high-head, large capacity station—is an auxiliary system of the Daya Bay nuclear plant and has a design total installed capacity of 1.2 million kilowatts. Investment in the station totals 1.4 billion yuan, including a loan of $200 million provided by the French Government. The main generators have been imported from France and the first unit is expected to be operating in 1993; the whole system will become operational in 1994.

Guizhou Stations Promote Rural Economic Development

40100001 Beijing XINHUA in English 0722 GMT 6 Oct 89

[Text] Beijing, October 6 (XINHUA)—Small hydropower stations have promoted economic development in rural areas of Guizhou Province in southwest China.

The province now has 2,343 hydropower stations in its rural areas, producing more than 800 million kWh of electricity. There was no electricity in these rural areas 33 years ago, according to today's PEOPLE'S DAILY.

Seventy percent of the townships and 48 percent of peasant households now have electricity.

Mountainous Guizhou Province has the richest water resources in China which can provide a combined electricity generating capacity of 15.23 million kW. For more than 30 years, the provincial government and local governments at various levels have followed a policy of developing the hydropower industry in order to help farmers escape poverty. They have adopted a policy of encouraging peasants to build their own water power stations.

The rapid development of the hydropower industry in rural areas has helped develop the economy. In 1988 the total output of rural enterprises was valued at 3.4 billion yuan compared with 190 million yuan in 1978. In the province's poorest county, Luodian, which had no electricity in the '60s, 36 percent of farming households now have electric lights which utilize nearby river resources.

State Council Approves Construction of Shuangliao Plant

40130003 Changchun JILIN RIBAO in Chinese 4 Oct 89 p 1

[Text] In order to reverse Jilin Province's long-standing energy shortage, the state and province have entered into a joint investment agreement to build the Shuangliao power plant. The project has been approved by the State Council and the State Planning Commission has assigned them the task of planning the facility.

The project calls for a total installed capacity of 240,000 kilowatts, with 120,000 kilowatts going in the first stage of construction; four Chinese-made coal-fired generators would be installed in this stage. All of the coal supply would come from the Huolinhe strip mine shipped directly to the plant via the Huotong-Dazheng line. The second stage would see the installation of two 600,000-kilowatt coal-fired units. The site of the plant is at the juncture of the three provinces of Liaoning, Jilin, and Nei Monggol, about 1.5 kilometers from Zhengjiatun (Shuangliao), a site very favorable for railroad transportation and the transformation and transmission of electricity.

So far, the engineering geology and hydrology surveys have been completed as has the project appraisal estimates.

Hebei Province Pushes Power Development

40100004B Beijing XINHUA in English 1113 GMT 26 Sep 89

[Text] Shijiazhuang, September 26 (XINHUA)—Six generating units with a generating capacity of 1.295 million kW are scheduled to go into operation in Hebei Province by the end of this year.

This is part of the effort being made by the Hebei Provincial Power Industry Bureau and Planning and Economic Committee to solve the province's power shortage.

The 658-kilometer-long high-tension transmission lines for the six projects will also be completed this year.

Hebei has built more than 80 power plants of above 500 kW with a total generating capacity of 5.3864 million kW. But that still cannot meet the needs of the province's economic development.

The province now urgently needs additional generating capacity of 1.30 million kW.

The provincial government plans to make full use of the coal sources in Hebei and its neighboring province Shanxi and has collected funds from the state, collectives and individuals to develop the power industry. Its investment in the power industry has kept growing at an annual rate of 24.2 percent for the past 5 years. Inviting bids, contracting and improving management have been used in developing the power industry.

This year, the province's four major cities, Xingtai, Baoding, Handan, and Shijiazhuang, plan to increase their generating capacity by 600,000 kW.

At present, five large and medium-sized power plants and power generating units are under construction in the province. They are the 200,000 kW unit of the Xingtai power plant, the 25,000 kW unit of the Handan power plant, the 600,000 kW units of the Shalingzi power plant in Zhangjiakou, the 700,000 kW generating units of the newly built Shangan power plant in Shijiazhuang and the 210,000 kW generating unit of Panjiakou power plant.

The five projects are expected to go into operation before 1990, helping to alleviate the electricity shortage in Hebei and Tianjin and Beijing cities.

Fulaerji No 6 Unit Put Into Operation

40130001 Harbin Heilongjiang Provincial Service in Mandarin 2200 GMT 29 Sep 89

[Excerpt] On the eve of the National Day, the No 6 generating unit of the Fulaerji power plant was fed into the northeast China power grid and put into test operation. Thus far, the total installed capacity of this plant has reached 1.35 million kW, ranking first among the thermal power plants in northeast China.

The No 6 generating unit is the last item of the second-stage project of the Fulaerji power plant. The second-stage project of this general plant is one of the 93 key construction projects of the state, with each consuming more than 500 million yuan of investment, during the period of the Seventh 5-Year Plan. During the periods of the Sixth and the Seventh 5-Year Plans, the state has installed six 200,000-kW turbogenerators by two stages at the Fulaerji power plant, with the total investment reaching 1.11 billion yuan. Since the start of construction in July 1978, the six generating units have been fed into the northeast China power grid one after another. [passage omitted]

Pingxu 600MW Unit Operating on Trial Basis

40130006 Guangzhou NANFANG RIBAO in Chinese 6 Nov 89 p 3

[Text] Hefei, 5 November—The 600,000-kilowatt Pingyu No 1 unit—to date the largest generator unit to be manufactured in China—was formally turned over for trial operations yesterday at the Huainan Pingxu power plant.

The technology for the generator was imported from the United States while the unit itself was manufactured by Harbin's steam turbine plant, electrical machinery plant and boiler works. Its level of automation is high and safety and reliability excellent. The cost effectiveness is high and the technology used is advanced. It employs computerized controls which were state-of-the-art in the early 1980's. After its trial period, it will become mainstay equipment in China in the decade of the 1990's.

Big Waigaoqiao Plant May Be Built

40130004 Shanghai JIEFANG RIBAO in Chinese 26 Sep 89 p 2

[Text] The Waigaoqiao power plant—the largest in terms of installed capacity in the Shanghai area—may be built in Pudong. Yesterday, the Electric Power Planning and Design Institute of the Ministry of Energy Resources convened a meeting to review a feasibility report on the Waigaoqiao power plant project in Shanghai. The meeting was chaired by the city's deputy mayor, Gu Chuanxun. In the first phase of construction on this power plant, four 300,000-kilowatt generating units would be installed. The plant would be a joint investment project involving the State Energy Investment Corporation, the Shanghai Shenneng Electric Power Development Company, the Huaneng Electric Power Corporation, and the Shanghai Electric Power Industry Bureau.

Domestic Coal Shortage Situation Seen Easing

906B0008 Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 10 Oct 89 p 3

[Text] At the third Qinhuangdao Coal Transport Conference convened a few days ago, those in attendance expressed relief. The State Council's target of a 6-million-ton winter coal reserve for power generation had been met early. The coal shortage in those provinces and municipalities which are major consumers of coal has eased. For this winter and next spring there are reliable guarantees for coal used in industrial and agricultural production, and in the lives of the people.

Qinhuangdao is an important port for the transshipment of northern coal southward. In order to ensure the pace of this year's electric power expansion, to make preparations for production early next year, and to arrange transport for winter coal stores, the State Planning Commission, along with the railways, communications, energy resources, and other concerned ministries, twice convened on-the-spot conferences at Qinhuangdao at the end of July. It was decided to regard the organization of Qinhuangdao's coal transport as a requirement of developing the national economy and ensuring the needs of the people's lives. In August and September, the coal transshipped through Qinhuangdao reached a new historical high, with a total of 9.5 million tons shipped. Taking the overall situation into account, major ports such as Qingdao, Shier, and Lianyungang fulfilled their tasks even though transport capacity was in short supply. According to statistics, as of the end of September, across the country, coal stocks for power generation had reached 6.83 million tons, an increase over the same period last year of 2.63 million tons. Coking coal stocks for metallurgical refining had reached 710,000 tons, close to last year's level. At the end of August, coal reserves for market use were 29.5 million tons, greater by 6.3 million tons compared with the same period last year.

Improvement in the transport of coal has spurred the expansion of electric power production. For August and September the average pace of thermal electric expansion nationwide exceeded the 5.12 percent expansion rate of the previous 7 months. The nationwide power generation output for September was 9.9 percent higher than for the same period last year.

In particular, it has been the Qinhuangdao coal transport which has ensured supplies of coal for power generation to the economically developed regions of east China and Guangdong. Beginning in August the east China power grid reversed the downward phase in thermal power of the previous 7 months. The coal supplies to the coastal provinces and municipalities of Shanghai, Jiangsu, Zhejiang, and Guangdong for industrial and market use are normal, and reserves have also increased by a relatively large amount.

Hebei Surpasses Production Quota

40130007 Shijiazhuang HEBEI RIBAO in Chinese 17 Oct 89 p 1

[Summary] During the January-September period this year, Hebei Province scored marked progress in coal production. Its raw coal output was 32.99 million tons, which accounts for 82.1 percent of the annual production plan. The province surpassed its coal production assignment by 3,519,400 tons during this period.

Of this output, 16.815 million tons, 74.2 percent of the annual production plan, were turned out by the collieries whose products are distributed under the state unified plan, which surpassed their production plan by 334,400 tons of coal during the period; and 16,175,400 tons, which accounts for 92.4 percent in the annual production plan were turned out by local collieries, which surpassed their production plan by 3.185 million tons of coal during the period.

New Mines Help Boost Henan Output

40100010 Beijing XINHUA in English 1535 GMT 24 Nov 89

[Text] Zhengzhou, November 24 (XINHUA)—With a coal mine producing 1.5 million tons a year newly opened, Henan Province's Yima Mining Administration will exceed 10 million tons in annual output this year.

By October, total output of the province had reached 71.2 million tons, 90.48 percent of the province's annual planned production, and an increase of 7.2 percent over output for the same period last year.

The reserves of coal in Henan Province total 20.91 billion tons, the seventh largest amount in the country, and the province's production has been second only to that of Shanxi Province, called "the sea of coal," since 1984.

Annual output this year is expected to reach 80 million tons.

With the increase in output, sales are also rising; 56.02 million tons of coal have been sold, 3.51 million tons more than in the same period last year, and at the same time, 1.88 million tons of coal more have been transported by rail than in the same 1988 period.

At present, 19 coal fields have been verified in Henan Province.

Shanxi Local Mines' Role in Easing Coal Shortage Stymied by Low Pricing

906B0007B Taiyuan SHANXI RIBAO in Chinese 2 Sep 89 p 1

[Excerpt] After 2 months of investigation the Provincial CPPCC conveyed to the State Council the necessity to stress the strategic status of Shanxi's local coal mines and

addressed potential crises in "Suggestions on Alleviating the Nationwide Coal Shortage."

The "Suggestions" pointed out that last year Shanxi's total coal output was 246 million tons of which local coal mines accounted for 61.5 percent. By the end of this century, Shanxi must realize a 400-million-ton [per year] target, of which local coal mines will be responsible for 200 million tons. Therefore, every kind of potential crisis existing in the local coal mines of Shanxi must be given high priority and solved. The strategic policy of support, development, reformation and improvement must be implemented, appropriate funding, pricing, transportation and sales policies formulated, and appropriate management systems organized to guarantee that the construction of the Shanxi coal base will proceed smoothly.

The "Suggestions" stated that increasing investment is an important prerequisite in creating sustained support for Shanxi's local mines. Today, the stamina of Shanxi's local coal mines, in particular the village and town coal mines, is woefully inadequate. If the mines are to continue to produce coal, then they must extend further and deeper. As a result, pumping, ventilation, bracing, transport and maintenance all require large injections of funds. However, since entering the "Seventh 5-Year Plan," state funding for the local coal mines of Shanxi has been gradually reduced. If this continues, these mines will not be usable in several years and a major crisis is certain to appear. It is recommended that the central government utilize state funds, and funds from provinces and municipalities which rely on coal usage and also attract outside funds to solve the problem of injecting investment into Shanxi's local coal mines.

The "Suggestions" state that today's excessively low coal pricing must be resolved. The present pricing is still that of 1985, while the pricing of primary and secondary materials has increased greatly. According to statistics, in 1988 the profit for a ton of coal of Shanxi's local, state-run coal mines was 1.42 yuan less than the profit for a ton of sand. The profit of village and town coal mines was only 0.58 yuan per ton, not worth the price of two chicken eggs. It is recommended that the state adopt formulation, within a specific time period, of maximum price limits on coal, and open up management methods. [passage omitted]

Ningxia To Play Larger Role in Coal Industry Development

906B0007A Yinchuan NINGXIA RIBAO in Chinese 5 Sep 89 p 1

[Excerpts] [Passage omitted] From 29 August to 1 September Comrades Yu Hongen, general manager of the State Coal Mining Corp., and Chen Dun, his deputy, inspected the Shizuishan and Shitanjin bureaus of mining, the Ningxia Coal Capital Construction Company and Northwest Coal Machinery's main factory. After listening to the reports of each organization regarding current production and tentative ideas for the "Eighth 5-Year Plan," Yu Hongen expressed views on Ningxia's strategy for development of coal production. He pointed out that by the end of the century, coal output nationwide must reach 1.4 billion tons. Only thus can the needs of quadrupling the national economy be ensured. Ningxia will shoulder a heavy responsibility in the course of shifting the focus of nationwide coal development construction westward and in the struggle over the next 10 years to realize the target of a 40-million-ton increase in output each year. This would require that the Shizuishan Mining Bureau, more advanced economically and technically, establish a modern mining bureau of two mines with integrated, mechanized coal extraction, an annual production capacity exceeding 5 million tons, and overall worker productivity of 2.5 to 3 tons in the Eighth 5-Year Plan. The Shitanjin Mining Bureau would have to exploit primary coking coal and anthracite coal, reach an annual output of 8 million tons by the end of the Eighth 5-Year Plan, achieve a level of mechanization exceeding 60 percent, and attain an overall worker productivity of 2 tons. [passage omitted]

Officials Optimistic About Meeting Offshore Production Target

40100002 Beijing CHINA DAILY in English 11 Oct 89 p 2

[Article by Yuan Zhou, staff reporter: "Offshore Oil Output Is on Target"]

[Text] China's fledgling offshore oil industry had produced 680,000 tons of crude oil by the end of September, fulfilling 75.5 percent of this year's plan.

China National Offshore Oil Corporation (CNOOC) officials said they were optimistic about the fulfillment of the year's target of 900,000 tons.

China's first three offshore fields—the Chenbei Oilfield in the Sino-Japanese co-operation zone, the BZ 28-1 oilfield in the Bohai Sea and the Wei 10-3 oilfield in the Sino-French co-operation zone in the Beibu Gulf—were put into production in recent years.

The corporation is to increase its annual offshore oil production to five million tons and natural gas output to 1.2 billion cubic metres by 1991.

For this, CNOOC has recently decided to concentrate on building six major projects: the Sino-Japanese BZ 34-2 oilfield in the Bohai Sea, the Huizhou 21-1 and 26-1 oilfields in the South China Sea in co-operation with the United States and Italy, the Jinzhou 20-2 and the Suizhong 36-1 oilfields in the Liaodong Gulf and Wei 11-4 oilfields in the Beibu Gulf.

China is constructing a total of eight offshore oil and gas fields, of which five are joint ventures.

According to the CNOOC officials, the nation's offshore oil industry has absorbed more than $2 billion worth of foreign investment. China has signed about 50 oil contracts and agreements with 45 companies from 12 countries, including the United States, Britain, Japan, Italy, Spain and Australia.

Last week, CNOOC signed two oil contracts with the American Amoco company for oil development in the South China Sea.

In the first half of this year, an 11,000-kilometre high-precision digital seismic survey line was carried out along China's coastal areas and 11 wells were drilled.

During the same period, the Lufeng 22-1-1 well was drilled in the South China Sea jointly by the Occidental Eastern Inc. and the CNOOC.

Another Sino-American joint venture, the Ya 13-1-6 appraisal well in the South China Sea, has an oil and gas flow equal to 1.14 million cubic metres of gas and 93 cubic metres of condensate.

In addition, the Lufeng 13-1-3, Liaodong Gulf Jinzhou 9-3-5, Beibu Gulf Wei 11-4N-4 and Liaodong Suizhong 36-1-19D wells also have oil and gas flows of industrial development.

The Huangyan 7-1-1 well, completed in June in the middle of the East China Sea, was found to have a flow equal to a daily output of 740,000 cubic metres of gas and 102 cubic metres of condensate.

Henan Now Fourth Biggest Oil Producer in Country

40100003A Beijing XINHUA in English 1040 GMT 19 Oct 89

[Text] Zhengzhou, October 19 (XINHUA)—Oil output from central China's Henan Province is now the fourth greatest in the country.

A provincial official in charge of the petroleum industry said that last year the province produced 65.24 million bbls of oil and 1.288 billion cubic meters of natural gas.

Developed in 1979, the Zhongyuan oil field increased its output by 38.36 percent to 50.54 million bbls last year.

The official said Henan was building a number of facilities, including a chemical plant with an annual capacity of 500,000 tons of urea, a polyethylene plant with an annual production capacity of 140,000 tons, and the expansion project of a refinery.

Argument for Eventual Conversion to FBR's Presented

90CF0010 Chongqing HE DONGLI GONGCHENG in Chinese Vol 10 No 4, Aug 89 pp 1-9

[Article by Li Zhihua [2621 2784 5478] and Chen Xin [7115 2450] of Qinghua University, Beijing, manuscript received 20 Feb 89: "Better Cycle Dynamic Model of Nuclear Fuel in China"]

[Excerpts]Abstract: In this paper, the system dynamics method is used to establish a model to study the dynamic development trend of nuclear power generation plants in several possible modes. A preliminary evaluation of these modes was done centered around the fuel cycling system by taking constraints in resources, economics, and technology into consideration. Problems associated with the nuclear power development process are also discussed. The models explored in this paper include the pure pressurized-water nuclear reactor, pressurized-water nuclear reactor + fast neutron breeder reactor, and a combination of nuclear fission and nuclear fusion hybrid reactor and light water reactor.

I. Introduction

Nuclear science and technology is an important part of modern science and technology and it is a key high technology to be focused on in developed nations in the world. It is urgent that we study the development strategy of nuclear technology and its position in science and technology development in China in order to formulate the guiding concept, goal, focus, approach, procedures and policy measures of our nuclear technology strategy based on the actual situation in China. To this end, a wide range of studies are being conducted by nuclear experts in China. The author of references [1, 2] points out that we should insist on using the pure pressurized-water reactor in the first generation nuclear power plants; the fast breeder reactor could become the primary energy source in China after 2040. However, in countries where the known uranium resources are limited, the number of reactors is relatively small, the cumulative experience in nuclear technology is relatively little because of a late start, and the use of fast breeder reactor has a limited impact on solving the uranium supply problem. Nevertheless, with the nuclear fusion breeder reactor, i.e., the hybrid coupled reactor, it may be possible to achieve rapid growth in nuclear power with less uranium because of its high support ratio. Some experts believe that priority should be given to the high temperature air cooled reactor. These opinions have something in common, i.e., China cannot depend on the pressurized-water reactor alone to develop nuclear power and must begin to consider the type of reactor to convert to in the 21st century. Since these views are arrived at from a number of studies on specific reactor types, it is difficult to make a comparison. Consequently, it would be difficult to make a comprehensive assessment. This paper attempts to study various types of reactors quantitatively by using a unified research tool in order to provide a preliminary view on the long-term development of nuclear power in China.

The research tool used in this work is system dynamics. This method has been successfully applied in sociology and economy. However, this is the first time it has been used in the development of the nuclear industry in China. [passage omitted]

III. Pure Pressurized-Water Reactor Nuclear Power Model

The current model to develop nuclear power in China is to develop pure pressurized-water nuclear reactors. It is also a mode to go through regardless of the type of reactors we decide to choose in the future. The pure pressurized reactor model includes two major parts: the nuclear power module and the nuclear fuel module. The nuclear power module includes the construction, operation, and retirement of the nuclear power plant. It takes factors such as electric power demand, capital, and technical level into consideration. The nuclear fuel module includes the mining and concentration of uranium, irradiation inside the reactor, and storage, processing, and recovery of spent fuel. It takes factors involving resources and technology into consideration. [passage omitted]

The time period of this dynamic study is between 1980 and 2050. Hence, the 1980 values are the initial values.

The pure pressurized-water reactor development model used the following 1980 parameters as its initial values:

(1) In 1980 the natural uranium reserve was calculated based on "30 years of operation at 15,000 MW" and it was valued at 75,000 tons.

(2) Experts estimated that the average natural uranium exploration rate was 1,500-2,000 tons/year in China. We chose to use the low limit, i.e., 1,500 tons/year.

(3) The existing natural uranium reserve in China does not have a major impact on the model. It was assumed to be 500 tons of natural uranium.

(4) The amount of natural uranium exploited in China was assumed to be 400 tons/year.

(5) China has a significant low level uranium reserve. However, it has little impact on this model. Compared to the total resources, it is relatively small. Therefore, it is set to be 0 ton.

(6) The amount of concentrated uranium in hand is assumed to be 60 tons.

(7) Four parameters, the amount of fuel inside reactors, the amount of spent fuel in storage, the amount of spent fuel processed, and the amount of uranium recovered, are set at 0 because China did not have a single nuclear power plant in operation in 1980. Hence, we did not have any fuel inside a reactor, any spent fuel in storage, any processed spent fuel, and any recovered uranium.

(8) In this model all new fuel elements are made of 3 percent concentrated uranium.

(9) The model assumes that unit reactor power increases with time as the technical level of pressurized-water reactor advances in China. Specifically, we will reach the 600 MW level by 1990, 900 MW level by 2010, and 1,200 MW level by 2040.

(10) This model picks different values for initial fuel load and annual fuel replacement per unit power for pressurized-water reactors of different power levels. The initial loading for a 600 MW level pressurized-water reactor is 0.093 ton per MW. The annual replacement amount is 0.03 ton per MW. The initial loading for a 900 MW level pressurized-water reactor is 0.082 ton per MW. The annual replacement amount is 0.027 ton per MW. The initial loading for a 1,200 MW level pressurized-water reactor is 0.075 ton per MW. The annual replacement amount is 0.024 ton per MW. The tonnage specified is the weight of the 3 percent concentrated uranium.

(11) This model assumes that the unit investment of a reactor is dependent upon its power. It is 3,150 yuan/kW at 600 MW, 2,600 yuan/kW at 900 MW, and 2,300 yuan/kW at 1,200 MW.

(12) This model also assumes that the load factor goes up as the technical level improves. Specifically, it is a linear function of time. The load factor is 0.60 in 1980 and increases by 0.02 per decade. It will reach 0.74 by 2050.

These data were input into the system dynamics program for computer simulation to obtain a large number of results. The time dependence of any quantity that appears in the model can be obtained through simulation. However, due to space limitation, it is neither possible nor necessary to provide all simulation parameters. This paper only shows numeric values of capacity related parameters which are directly relevant to the development of nuclear power. Table 1 and Figure 2 show the values and curve of total installed capacity as a function of time, respectively

Table 1. Dynamic Changes of Construction and Operating Capacity of Pressurized-Water Reactors

Year	Annual newly installed capacity, MW	Cumulative capacity under construction, MW	Annual additional operating capacity, MW	Cumulative operating capacity, MW	Annual retired capacity, MW
1980	290	300	50	50	10
1984	100	540	100	360	10
1988	600	2040	100	710	10
1992	600	3610	440	1500	20
1996	1550	5150	560	3430	30
2000	1530	8480	750	6140	60
2004	1260	9390	1360	10500	110
2008	1070	9970	1440	15400	200
2012	0	5560	1110	20320	310
2016	0	2390	480	22000	450
2020	0	1030	210	21330	570
2024	0	440	90	19840	650
2028	0	190	40	17080	670
2032	0	80	20	14510	650
2036	0	40	10	12010	600
2040	0	20	0	9750	530
2044	0	10	0	7760	450
2048	0	0	0	6070	380

From Table 1 and Figure 2 we can see that:

(1) Due to limited nuclear resources in China, we cannot build any more pressurized-water reactors after 2008. This means that China's nuclear resources can only supply pressurized-water reactors for 28 years.

(2) If the lowest single reactor power is 600 MW, there will be no new pressurized-water reactor put in operation

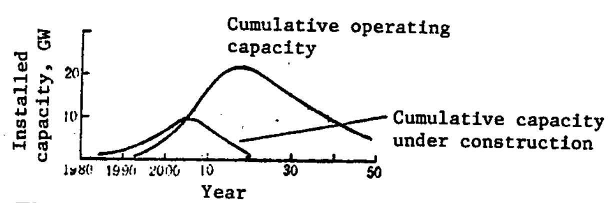

Figure 2. Dynamic Curve of Total Installed Capacity in the Pure Pressurized-Water Reactor Development Model

after 2014. If lowest single reactor power is 300 MW, there will be no new pressurized-water reactor put in operation after 2018.

(3) Due to limited nuclear resources, the maximum cumulative pressurized-water reactor capacity in China is 22,000 MW. It will be reached by the year 2016. If we do not import new types of reactors, it is impossible to reach the goal of 30,000 MW.[5]

(4) There is an 8-year delay between the peak of the total cumulative installed capacity in operation and the peak of total installed capacity constructed.

The pure pressurized-water reactor model has two different modes. One is that concentrated uranium is recycled, but plutonium is not recycled. The other is that both uranium and plutonium are not recycled. The above four conclusions are obtained based on the uranium recovery mode of the pure pressurized-water reactor development model. As for the one-pass pressurized-water reactor model, the simulation curve is very similar to that of the uranium recycle mode. The only difference is that the cumulative total installed capacity peaks 2 years earlier, i.e., in 2016. There are no other differences.

Results of sensitivity calculation shows that if the exploration rate of natural uranium is raised from 1,500 to 2,500 tons/year, the cumulative total installed capacity will go up to 28,000 MW from 22,000 MW. However, it will still not reach 30,000 MW. The peaking time remains unchanged. This indicates that accelerating exploration can help us enlarge the scale of nuclear power. However, it cannot delay the decline of nuclear power based on pressurized-water reactors. The decline of pressurized-water reactor based nuclear power due to constraints related to nuclear resources cannot be solved by increasing the supply of uranium. It must depend upon improvement of reactor type and raising fuel efficiency.

IV. Hybrid Nuclear Power Model With Pressurized-Water Reactor and Fast Breeder Reactor

The hybrid pressurized-water reactor and fast breeder reactor model employs the plutonium produced by the pressurized-water reactor on a cumulative basis as the initial fuel for the fast breeder reactor. Since the conversion ratio of the breeder reactor is greater than 1, the amount of plutonium produced is larger than that consumed. Therefore, the plutonium produced by a breeder reactor can equip more breeder reactors. The recycling material used to produce plutonium in a breeder reactor is uranium-238. This material is not used in a thermal pile. Therefore, a breeder reactor and pressurized-water reactor hybrid model can more effectively utilize natural uranium fuel than a pure pressurized-water reactor model.

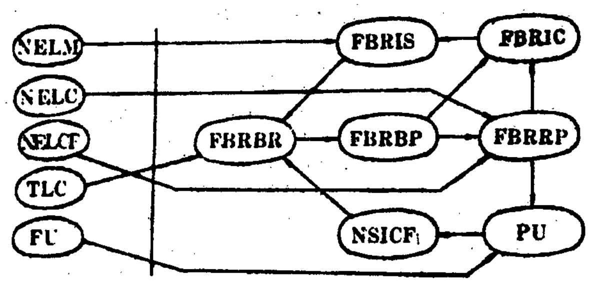

Figure 3. Cause and Effect Diagram of the Pressurized-Water Reactor and Fast Breeder Reactor Hybrid Model

FBRIS—fast breeder reactor investment sum; FBRIC—fast breeder reactor investment construction cost; FBRBR—fast breeder reactor annual new installation capacity; FBRBP—fast breeder reactor total capacity under construction; FBRRP—fast breeder reactor total operating capacity; NSICF—factor affected by plutonium resources; PR—plutonium in stock

The cause and effect diagram of the fast breeder reactor and pressurized-water reactor hybrid model can be constructed by adding the cause and effect diagram of the breeder reactor to that of the pure pressurized-water reactor model (see Figure 3).

The right side of Figure 3 is the new addition of the cause and effect diagram of the breeder reactor. The figure only shows connections between the pressurized-water reactor and breeder reactor. The original cause and effect relations of the pure pressurized-water reactor are omitted.

The following initial data (1980) is used in the pressurized-water reactor and fast breeder reactor hybrid model:

(1) The amount of plutonium in hand is chosen to be zero in this model because there was no pressurized-water reactor and fast breeder reactor in China in 1980. Therefore, the amount of industrial plutonium in hand was zero.

(2) Because China did not begin building any fast breeder reactor in 1980, the newly installed capacity per year and total installed capacity are zero.

(3) This model assumes that a 1,000 MW fast breeder reactor requires 5 tons of industrial plutonium as its initial fuel.

(4) With regard to the net plutonium production capacity, investment ratio and technical factor, the model assumes that the amount of net plutonium production increases, investment ratio decreases, and technical factor increases with advances in fast breeder reactor technology. Specifically, the parameters are shown in Table 2.

Table 2. Net Plutonium Production Capacity, Investment Ratio and Technical Factor of a Fast Breeder Reactor

Year	1980	1990	2000	2010	2020	2030	2040	2050
Net amount of plutonium produced, kg/MW	.4	.4	.4	.43	.46	.5	.7	.7
Investment ratio, 100,000,000 yuan/MW	.054	.054	.054	.053	.051	.049	.047	.044
Technical factor	0	0	0	0.3	0.6	0.9	1	1

(5) Similar to the pressurized-water reactor model, the rate of exploration of natural uranium is assumed to be 1,500 tons/year.

(6) As for the time and rate of construction of fast breeder reactors, the model assumes that we begin construction in 2010. Initially, we will build a 1,000 MW fast breeder reactor every 5 years. The rate will pick up later.

After we input these data into the system dynamics program, the dynamic changes of the total installed capacity can be obtained in the form of a curve as shown in Figure 4.

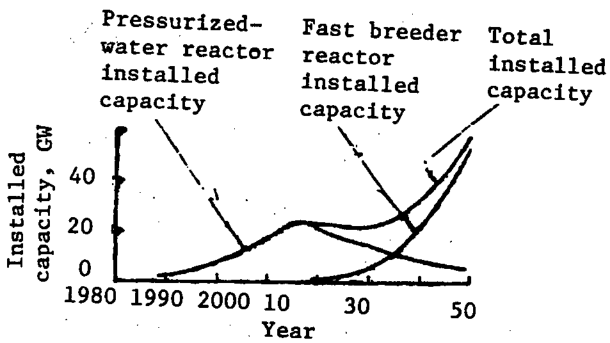

Figure 4. Dynamic Curves of Total Installed Capacity Based on the Pressurized-Water Reactor and Fast Breeder Reactor Hybrid Model

Figure 4 shows that when we begin to build fast breeder reactors in 2010, pressurized-water reactors will peak soon. Because the fuel multiplication time of a fast breeder reactor is longer, the growth in breeder reactor installed capacity will be slower than the decline in the pressurized-water reactor. The constraints imposed on the pressurized-water reactor due to limited nuclear resources and capital affect the development of fast breeder reactors. Between 2015 and 2035, the total installed capacity of nuclear power not only will not grow rapidly but also will show a slight dip. The total capacity will remain in the 20,000-22,000 MW range in this period of time. In order to prevent such a stagnation, there are three possible approaches:

(1) Delay the peaking time of the pressurized-water reactor. This is actually equivalent to slowing the growth of nuclear power completely. It is not a viable approach.

(2) Move up the schedule to put fast breeder reactors in operation. If fast breeders can be put into operation in 1990, then the slight dip in the curve will become a slight rise. However, it is impossible to move the time up to 1990. It would even be very difficult to achieve it by 2000.

(3) Introduce a high conversion reactor. The high temperature air-cooled reactor is a high conversion reactor. Nevertheless, a high conversion reactor may be a high temperature air-cooled reactor or an improved pressurized-water reactor with more densely spaced grids.

Figure 5 shows the simulation results with the high conversion reactor added to the pressurized-water reactor and breeder reactor hybrid model.

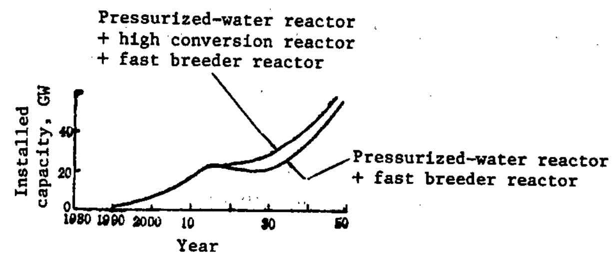

Figure 5. Dynamic Curve of Total Installed Capacity With High Conversion Reactor Inserted Between Pressurized-Water Reactor and Fast Breeder Reactor

From Figure 5, after the addition of high conversion reactors between pressurized-water reactors and fast breeder reactors, the total capacity curve is raised. Originally, the curve between 2016 and 2030 shows a slight dip. Then, it rises slowly. This changes the stagnation or slight decline of nuclear power in this period to a continuous growth situation. Nevertheless, the growth is still slower than that in the previous period. In conclusion, it is favorable to include high conversion reactors in between pressurized-water reactors and fast breeder reactors in the development of nuclear electric power in China.

V. Symbiotic Nuclear Power Development Model Involving Fusion and Fission Hybrid Reactor and Light Water Reactor

In this model the light water reactor does not play the same role as the pressurized-water reactor in the two earlier models. This light water reactor uses the high quality ^{233}U fuel produced by the hybrid reactor. Here, the light water reactor is a nuclear electricity generating unit. It is obvious that the hybrid reactor is responsible

for producing high quality fuel and the light water reactor is responsible for generating electricity in this system.

The cause and effect diagram of the model of the symbiotic hybrid reactor and light water reactor system can be handled in the same manner as we did with the pressurized-water reactor and fast breeder reactor combination. It is done by adding the cause and effect reactions of the hybrid reactor and light water reactor system on top of the existing diagram for the pressurized-water reactor. In reality, due to technical reasons, it is highly unlikely for this system to become operational before 2030. By then, the pressurized-water reactor system will be on its way out. Therefore, this model can be simplified. Figure 6 shows the cause and effect diagram of the model based on the hybrid reactor and light water reactor symbiotic system.

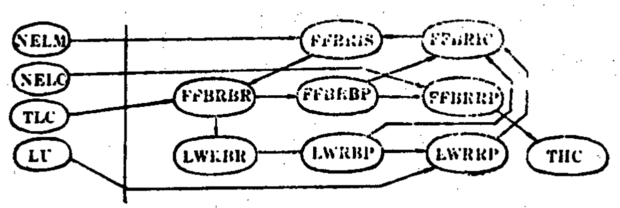

Figure 6. Cause and Effect Diagram of the Hybrid Reactor and Light Water Reactor Symbiotic System

FFBRIS—investment on the hybrid reactor and light water reactor system; FFBRIC—capital required for the hybrid reactor and light water reactor system; FFBRBR—annual capacity of newly installed hybrid reactor and light water reactor system; FFBRBP—total capacity of the hybrid reactor and light water reactor system under construction; FFBRRP—total operating capacity of the hybrid reactor and light water reactor system; LWRBR—annual capacity of newly installed light water reactors; LWRBP—total capacity of light water reactors; LWRRP—total operating capacity of light water reactors; THC—thorium capacity

The cause and effect diagram of the model based on the hybrid reactor and light water rector symbiotic system is shown to the right of the vertical line in Figure 6. To the left the line shows the relevant elements in the pressurized-water reactor diagram.

The following initial data (1980) is used in the hybrid reactor and light water reactor system model:

(1) Since the hybrid reactor and light water reactor system did not exist in 1980, the initial thorium used, annual capacity of newly installed system, total capacity of systems under construction, annual capacity of newly installed light water reactors, and total capacity of light water reactors are all zero.

(2) Let us assume that the net multiplication factor of the symbiotic system is 1.68.

(3) Let the amount of ^{233}U produced by a unit power of the hybrid reactor be 4.67 kg/MW.

(4) In the symbiotic system, a hybrid reactor can supply the nuclear fuel necessary to several light water reactors of the same power. This is defined as the support ratio. In this paper, this support ratio is 10.

(5) It is believed that the investment ratio of the hybrid reactor is 3.5 times that of the light water reactor.

(6) It is believed that hybrid reactor technology will be sufficiently mature for commercialization by 2030. Specifically, the technical factors are as follows: 1980-2030 is 0, 2040 is 0.4, and 2050 is 0.8.

When we input these data into the system dynamics program, we get the dynamic change curve of total capacity shown in Figure 7.

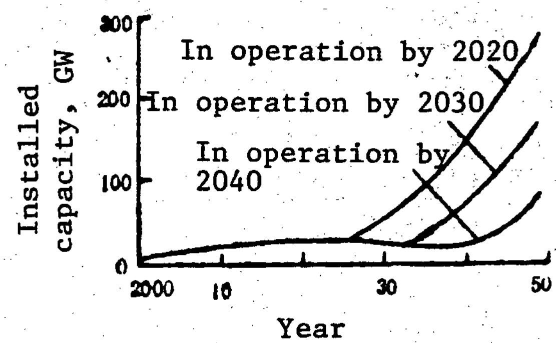

Figure 7. Dynamic Curve of Total Capacity of the Hybrid Reactor and Light Water Reactor Symbiotic System

From Figure 7 we can see that:

(1) The slope of the curve of the hybrid reactor and light water reactor system is much steeper than that of the pressurized-water reactor and fast breeder reactor combination. It takes much shorter time from the start to reaching a considerable capacity compared to the fast breeder reactor. This indicates that the hybrid reactor and light water reactor system will play an important role in the development of nuclear power in China.

(2) From the dynamic curve corresponding to putting the system in operation in 2030, we can see a slight decline between 2015 and 2035, very similar to that of the fast breeder reactor model. However, if it is put in operation in 2020, the dynamic curve does not show any significant drop. Furthermore, installed capacity increases very rapidly. This demonstrates the critical nature of putting the hybrid reactor and light water reactor system in operation as soon as possible.

The constraints on the hybrid reactor and light water reactor symbiotic system are not imposed by nuclear resources. Rather, they are related to technology and

funding. This is one less constraint compared to the pressurized-water reactor and fast breeder reactor model.

VI. Comprehensive Model for the Development of Nuclear Power in China

Based on the system dynamics simulation results described above, we recommend the following comprehensive nuclear power development model:

(1) Based on our existing nuclear resources, capital and technology, the first generation of nuclear reactors should be pure pressurized-water reactors. We should also develop high conversion reactors, such as making improvements on the pressurized-water reactor or using other types of high conversion reactors, as early as possible.

(2) Fast breeder reactor should be developed as soon as possible. It should be in commercial operation by or before 2010.

(3) We should make an early breakthrough in the hybrid and light water reactor symbiotic system and make an attempt to put it in commercial operation by or before 2030.

Based on the above assumptions, we can obtain the simulation results of the comprehensive model. Figure 8 shows the dynamic curve of the total nuclear capacity between 1980 and 2050.

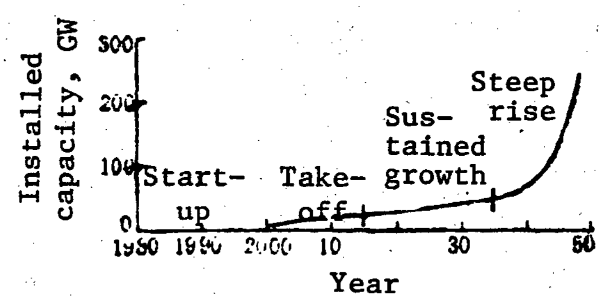

Figure 8. Dynamic Curve of China's Comprehensive Nuclear Power Development Model

From Figure 8 we can see that the nuclear power development process will go through four stages. The first stage is between 1980 and 2000 and this is the start-up period. During this period, nuclear power is constructed from scratch. By 2000, the total installed capacity will be approximately 6,000 MW. This will serve as a foundation for the nuclear power industry in China to take the next step. The second stage is between 2000 and 2015 and it is the take-off period. The growth in nuclear power is primarily relying on pure pressurized-water reactors in this period. It is estimated that the total capacity will reach 22,000 MW at the end of this period. During this period, high conversion reactors will be operational and fast breeder reactors will be developed, demonstrated, and commercialized. The development of the hybrid reactor and light water reactor system will also attain a certain level. The third period is between 2015 and 2035 and it is a sustained growth period for the nuclear power industry in China. During this period, the nuclear power industry in China will convert to fast breeder reactors from pure pressurized-water reactors and fast breeder reactors will play a major role in nuclear electricity. In addition, the hybrid reactor and light water reactor symbiotic system will move from development into commercialization. In this stage the installed capacity will rise from 22,000 MW to approximately 40,000 MW. This will be the foundation for the rapid growth of nuclear power in the next phase. The fourth stage begins in 2050. It is the steep rise period. In this period the fast breeder reactors and the hybrid reactor and light water reactor systems will be simultaneously effective. The total operating capacity will exceed 200 GW. Nuclear power begins to play a critical role in energy resources. However, despite so, nuclear power still cannot meet our power demands prior to 2050.

VII. Conclusions

(1) Preliminary success was obtained by using system dynamics to study the nuclear power development strategy. This demonstrated that we should pay attention to soft science in nuclear power development in China. Policies ought to be made with scientific means to avoid mistakes.

(2) There are four stages in nuclear power development, i.e., start-up, take-off, sustained growth, and steep rise. We are in a preparation stage in this century. The 21st century is a nuclear power century. Nuclear power will find a place in energy resources.

(3) Pressurized-water reactor, high conversion reactor, fast breeder reactor, and hybrid reactor and light water reactor symbiotic system are indispensable in developing nuclear power in China. They are useful at various stages in the process. If funds are available, the technology associated with reactors ought to be developed promptly for early commercialization. The earlier they are put in commercial operation the more effective they are in developing nuclear power in China.

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New Fuel From Coal May Ease Shortages

*40100011 Beijing CHINA DAILY in English
2 Dec 89 p 3*

[Text] The developer of a new coal tar-based fuel oil says his product is "an ideal substitute" for diesel oil.

The product, called 101 Fuel Oil, is a mixture made up 40 per cent of water, coal tar and an emulsifying agent. It was developed by Ren Chunshan, director of the Research Institute for Practical Technologies of Dongling District in Shenyang, the capital of Liaoning Province.

At the end of last year, his formula passed the technical appraisal of the Shenyang Municipal Science and Technology Commission. More recently, it won the golden prize of "Sparkling" award given by the State Science and Technology Commission. A patent application has been filed.

According to Ren, different versions of the fuel oil can be made to achieve maximum fuel efficiency in accordance with seasonal changes.

Ren said it took him 101 experiments over four years, before he succeeded in producing the fuel oil last year.

Experts of the Shenyang Science and Technology Commission claim the invention is a "breakthrough" in the search for new energy resources. They say their tests have shown the exhaust of the 101 Fuel Oil contains low levels of pollutants.

Qin Zhongyi, general engineer of the Ministry of Energy Resources, said, "The achievement, which turns coal into fuel oil with little investment, has great economic value and at the same time accords with China's present energy developing policy."

China is encouraging ways of developing new energy resources and saving the available ones.

Energy experts from the ministry believe the 101 Fuel Oil has bright development prospects because the raw materials for its production are abundant and the equipment needed for its production is simple and, therefore, not costly.

Some experts said the product can be widely used, especially in the countryside since more and more farmers in China are buying trucks, thereby aggravating energy shortages.

And since the fuel oil leaves no unwanted carbon after burning, engines using the product will have a longer life span than those using ordinary diesel oil, Ren said.

According to Ren, the product is used, stored, packaged and transported in exactly the same way as diesel oil.

Inner Mongolia Makes Good Use of Wind, Solar Power

*40100003B Beijing XINHUA in English 1302 GMT
12 Oct 89*

[Text] Inner Mongolia, October 12 (XINHUA)—The development of wind power has brought electric lights to the homes of more than 70,000 herding families and also taken up the slack in electric power supply for small industries in the Inner Mongolia Autonomous Region.

The region has rich wind, solar and biological energy resources. On the grasslands, the potential wind capacity amounts to 250 million kWh of electricity, the country's highest.

Because the population density in pastoral areas is only two to three people per square kilometer, it is difficult to build an electrical power network. The autonomous region has taken advantage of its own energy resources to develop the power industry. Technical problems were solved by using small wind power generators to provide electricity. Now herdsmen can watch TV.

More than 70,000 wind power generators have been set up on the grasslands. Twenty-two percent of the herding families now have electricity. More than 3,000 solar energy batteries, 4,000 methane-generating pits and 5,000 square meters of lamb sheds heated with solar energy systems have been set up.

The development of various sources of energy in the region has brought good economic results. A joint scientific body consisting of seven research institutes, four universities and 17 industrial enterprises has been organized in the region to further develop the energy industry.